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NEST SUBSTRATE VARIATION BETWEEN NATIVE AND INTRODUCED POPULATIONS OF LAYSAN FINCHES

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ABSTRACT.—On Laysan Island, the endangered, endemic Laysan Finch (*Telespiza cantans*) nests almost exclusively in the native bunchgrass *Eragrostis variabilis*. Experimental nest boxes provided were never used for nesting. Marine debris was not used as nest substrate on Laysan Island. In contrast, the introduced Laysan Finch populations on four islands at Pearl and Hermes Reef used a wide variety of native and alien plants as nest substrates, as well as various kinds of human-made debris. However, nest boxes provided at Pearl and Hermes Reef were not used as nest substrates by finches. *Eragrostis variabilis* is uncommon on Pearl and Hermes Reef, except on Seal-Kittery Island, but is common on Laysan where it is the preferred nest substrate. *Eragrostis* is a dense bunchgrass which probably provides the nest with good protection from sun, rain, wind, disturbance, and predators. On Pearl and Hermes Reef, where *Eragrostis variabilis* is uncommon, other plants that provide dense cover are used as nest substrates, and human-made debris that provides some cover is also utilized. It is unclear why nest boxes were never used as nest substrates at either site. We suggest that the conservation of Laysan Finches on Laysan Island will require the maintenance of a native ecosystem where *Eragrostis variabilis* is a major vegetation component. Otherwise, changes in behavior, morphology, and energy expenditure associated with environmental differences are likely to occur, and may have already occurred in the introduced populations on Pearl and Hermes Reef. *Received 13 Nov. 1989, accepted 23 Mar. 1990.*

The endangered Laysan Finch (*Telespiza cantans,* Wilson 1890) is a little known Hawaiian honeycreeper (Fringillidae: Drepanidinae). It is considered an endangered species due to its small natural distribution and its extreme vulnerability to predators and disease (USFWS 1984, van Riper and van Riper 1985:331, Throp 1970). Laysan Finches are known from the islands of Oahu and Molokai as fossils (Olson and James 1982). Historically, Laysan Finches are known to occur naturally only on Laysan Island (Fig. 1), although a small population now also occurs on four of the islands at Pearl and Hermes Reef (PHR; Fig. 2) to which finches were introduced in 1967 (Amerson et al. 1974). At both of these sites, Laysan Finches are the only passerine birds present, although seabirds are numerous and shorebirds are seasonally common. Laysan and PHR are uninhabited except for periodic visits by research biologists. The islands are part of the Hawaiian Islands National Wildlife Refuge which is administered by the U.S. Fish and Wildlife Service.

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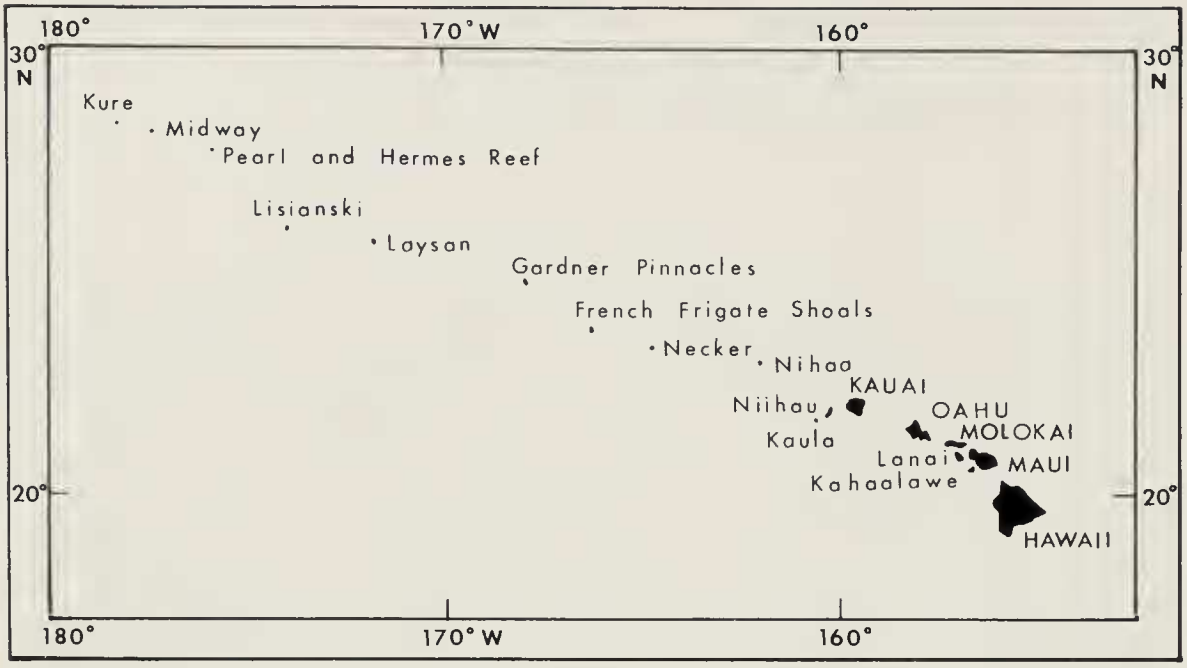

FIG. 1. Map of the Hawaiian archipelago showing the locations of Laysan Island and Pearl and Hermes Reef.

Laysan has a total area of about 397 ha, of which 187 ha are vegetated. This island supports approximately 10,000 Laysan Finches (see Table 1 in U.S. Fish and Wildlife Service 1984). The four main vegetated islands in PHR total 56.2 ha in area, of which 21.3 ha are vegetated (Conant 1988). The current population from this 1967 introduction numbers about 800 birds (Table 1).

Conant has researched the Laysan Finch on Laysan and PHR since 1984, and Morin studied the Laysan Island population from 1986 through 1988. Our work has included records of Laysan Finch nest-site substrates;

TABLE 1

ISLAND SIZE, SUITABLE HABITAT AREA AND LAYSAN FINCH POPULATION SIZE[a]

	Total area (ha)	Vegetated area (ha)	Estimated finch population
Laysan	397	187	10,000
Pearl and Hermes Reef	56.2 (total)	21.3 (total)	820 (total)
Southeast Island	13.8	12.5	520
North Island	6.4	4.4	200
Grass Island	4.4	2.2	50
Seal-Kittery Island	31.6	2.2	50

[a] U.S. Fish and Wildlife Service (1984).

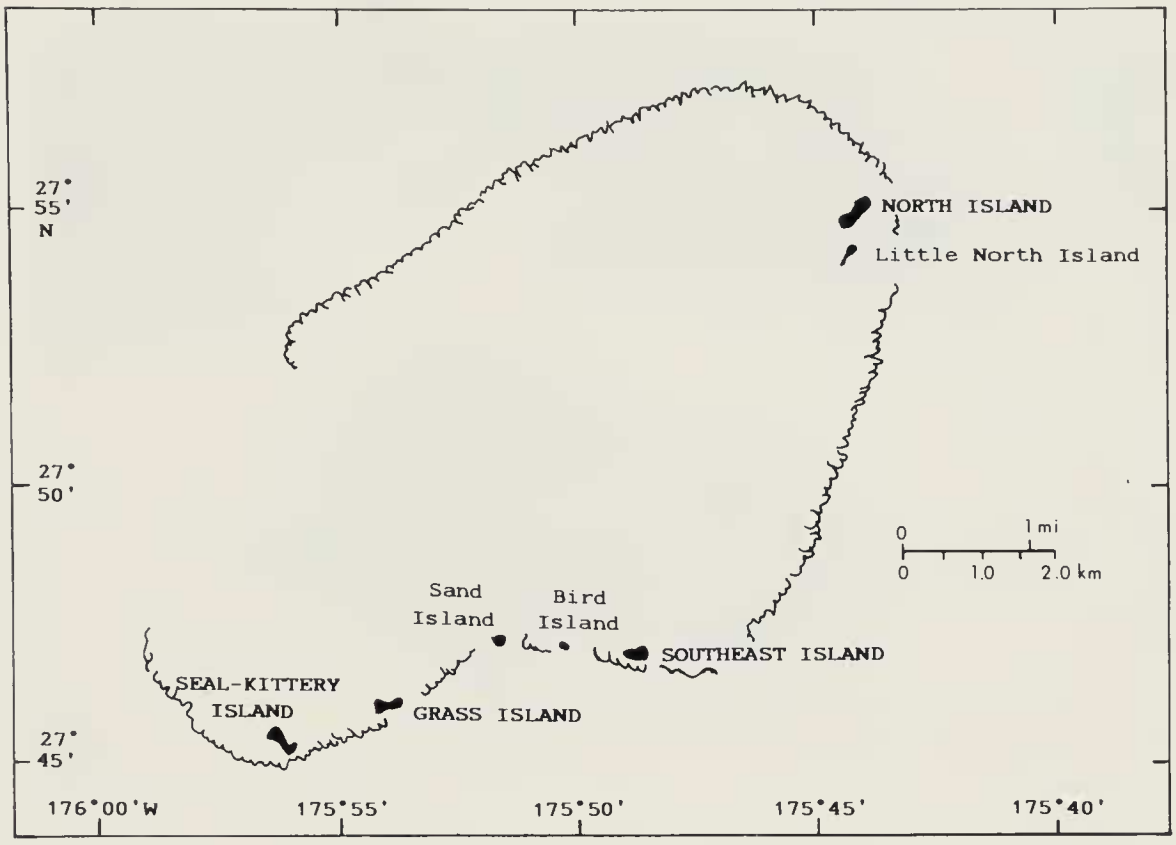

FIG. 2. Map of Pearl and Hermes Reef. Names of islands with Laysan Finch populations are printed in capital letters.

we have also gathered anecdotal information from other researchers (L. Hiruki, B. Choy, C. Rowland and K. McDermond, unpubl. data). Using those data we document in this paper differences in nest-site selection on Laysan versus PHR. The differences appear to be at least partly due to the presence or absence of certain nest substrates.

MATERIALS AND METHODS

In 1986, 62 nest boxes were erected in the northwest quadrant of Laysan Island in an attempt to facilitate the location and monitoring of finch nests. Fifty of the nest boxes were made of plywood, and the remainder were plastic or aluminum elbow pipes and concrete cinder blocks. The nest boxes were randomly located, half of them within *Eragrostis variabilis* clumps, and all but the cinder blocks were approximately 0.3 m above the ground anchored to a stake. Nest boxes were at least 4.5 m from each other, and all were placed in the *Eragrostis* vegetation association (Lamoureux 1963, Newman 1988). The boxes were taken down at the end of the 1986 field season on Laysan. In 1987 20 were reerected on Laysan, and 20 were erected on Pearl and Hermes Reef, where they were placed directly on the ground in the sparse vegetation. All nest boxes were removed from Laysan at the end of the field season in 1988, and most of the boxes at Pearl and Hermes Reef had disintegrated by August of 1989.

Natural nest sites were located on PHR from 1984 to 1989 by Conant and on Laysan

FIG. 3. A clump of the bunchgrass *Eragrostis variabilis* on Laysan Island. When it was photographed, this clump contained an active Laysan Finch nest.

from 1986 to 1988 by Morin. These were discovered using a variety of cues, including male song, female and nestling begging calls, courtship feeding, and by following females with nesting material. Unless otherwise noted, only nests which contained eggs and/or chicks are included in the results section.

During a one-day visit to PHR in 1983 Conant (on Southeast and North Islands) and Gagne (on Grass and Seal-Kittery islands) estimated the number of *Eragrostis* clumps on the four vegetated PHR islands. In July 1989, Conant counted *Eragrostis* clumps on each of the four PHR islands with finches. On Laysan, she counted *Eragrostis* clumps in 30 10 m × 10 m quadrats, with quadrats in the two major vegetation associations where the bunchgrass occurs: 10 in the viney association (*Ipomoea-Boerhavia-Sicyos-Eragrostis*) and 20 in the pure bunchgrass (*Eragrostis*) association. On both Laysan and PHR, Conant noted that she did not count the small (under about 15 cm in diameter) clumps. All plant names used in this paper follow Wagner et al. (1990).

RESULTS

Not a single wooden, pipe, or cement nest box was used as a nest substrate on Laysan in 1986, 1987, or 1988, although in 1987 a finch made a natural nest in the bunchgrass (*Eragrostis variabilis*) 31 cm in front of a wooden nest box in the same bunchgrass clump. The 20 wooden nest boxes placed on PHR in 1987 were erected too late in that breeding season to be used that year. Half of the PHR nest boxes were checked by other researchers in 1988 and all were checked by Conant in 1989, but

TABLE 2
LAYSAN FINCH NEST SUBSTRATES ON LAYSAN ISLAND AND PEARL AND HERMES REEF

	Setaria	*Solanum*	*Tribulus*	*Erag*	*Erag*[a]	Other	Debris[b]
Laysan	0	0	0	199	69	2	0
Pearl and Hermes Reef							
Southeast Island	38	1	0	0	0	7	8
North Island	0	5	4	1	0	5	0
Grass Island	0	1	0	0	0	1	0
Seal-Kittery Island	1	0	0	0	1	1	0
PHR totals	39	7	4	1	1	14	8.

[a] *Eragrostis* with one or more other plant species on or mixed in the clump.
[b] The "debris" category includes such items as plastic crates, "Sono-Buoy" tubes, fishing gear, bamboo poles, a plastic bucket, pipes, hard hats, a TV set, old fuel containers, a generator, swim fins, and a wetsuit.

none had been used. On both Laysan and Pearl and Hermes, Laysan Finches and a variety of seabirds were observed loafing or roosting on or in the shade of the boxes.

Over 270 nests with eggs or chicks were located in natural substrates on Laysan from 1986 to 1988. Of those nests, 73.7% were in *Eragrostis* alone, and 25.5% were in *Eragrostis* with one or more other plant species in or on the bunchgrass clump; only two (<1.0%) of the nests were situated on other substrates. Over 99% were situated in *Eragrostis* (Fig. 3) or were in *Eragrostis* mixed with one or more other plant species (Table 2). When other species were part of the substrate, *Eragrostis* was nearly always the dominant plant, usually with a vine of some sort (most commonly the morning glory *Ipomoea pes-caprae* and/or the native cucumber *Sicyos maximowiczii*) growing over the bunchgrass clump. Only two Laysan nests did not have *Eragrostis* as some or all of the substrate; one was a nest found on the ground under the sedge *Cyperus laevigatus* and the other was a nest built on very low branches of a dead *Pluchea indica* bush heavily overgrown with the succulent ground cover *Sesuvium portulacastrum.*

On PHR the grass *Setaria verticillata* was the most common (38 out of 46) natural nest substrate recorded on Southeast Island. The perennial shrub *Solanum nelsonii* (five out of 12) and the annual herb *Tribulus cistoides* were the most common nest sites on North Island (see Table 2). Other plant species, including *Lepturus repens, Lepidium bidentatum, Boerhavia repens,* and various combinations were used as well. There were several nests built under both active and abandoned Great Frigatebird (*Fregata minor*) nests (particularly in 1989), and a single nest found

TABLE 3

LIST OF PLANT SPECIES ON LAYSAN ISLAND AND THE FOUR VEGETATED ISLANDS OF PEARL AND HERMES REEF[a]

Plant species (status) (alphabetical order)	Laysan	Southeast	North	Grass	Seal-Kittery
Boerhavia repens (I[b])	+	+	+	+	+
Brassica campestris (A)		+			
Casuarina equisetifolia (A)	+				
Cenchrus echinatus (A)	+				
Chenopodium oahuense (H)	+				
Cocos nucifera (A)	+				
Conyza bonariensis (A)	+				
Coronopus didymus (A)		+			
Cynodon dactylon (A)	+	+			
Cyperus laevigatus (I)	+				
Eragrostis paupera (I)		+	+[f]		
E. variabilis (H[c])	+	+	+	+	+
Fimbristylis cymosa subsp. *spathacea* (I)	+				
F. cymosa subsp. *umbello-capitata* (I)	+				
Heliotropium currasavicum (I)	+				
Ipomoea indica (I)	+				
I. pes-caprae subsp. *brasiliensis* (I)	+				
Lepidium bidentatum var. *o-waihiense* (H)		+	+	+	+
Lepturus repens (I)	+	+	+	+	+
Malvastrum coromandelianum (A)		+			
Mariscus pennatiformis subsp. *bryanii* (L[e])	+				
Nama sandwicensis (H)	+				
Nicotiana tabacum (A)	+				
Pluchea indica (A)	+				
Portulaca lutea (I)	+	+			
P. oleracea (A[d])	+	+[f]	+[f]		
Scaevola sericea	+				
Sesuvium portulacastrum (I)	+	+		+	+
Setaria verticillata (A)		+		+	+[f]
Sicyos maximowiczii (H)	+	+	+	+[f]	+
S. pachycarpus (H)	+				
S. semitonsus (H)	+				
Solanum americanum (A)	+	+			
S. nelsonii (H)		+	+	+	+
Sonchrus oleraceus (A)		+			
Tournefortia argentea (A)	+	+			
Tribulus cistoides (I)	+	+	+	+	+

[a] This list includes all species of plants observed or collected from 1983 through 1989, except that *Portulaca oleracea* and *Eragrostis paupera* were seen but not collected on North Island. Historically, other species were known from the islands.

[b] I = Indigenous to the Hawaiian Islands.

[c] H = Endemic to the Hawaiian Islands.

[d] A = Alien, introduced to the Hawaiian Islands.

[e] L = Endemic to Laysan Island.

[f] New island record (Herbst and Wagner, 1990, this study).

FIG. 4. A two- or three-gallon plastic container for liquids containing an old Laysan Finch nest at Southeast Island, Pearl and Hermes Reef. The side of the container was cracked off and removed so the nest could be photographed. Apparently finches entered the container through its neck or "spout."

in a partially collapsed seabird burrow on North Island. Table 3 is a list (alphabetic) of all plants that were observed or collected on Laysan and the four vegetated islands of PHR from 1983 through 1989 (Newman 1988, Herbst and Wagner, in press, Morin and Conant, unpubl. data). Nearly all plant records are substantiated by voucher specimens collected by Conant and deposited in the Department of Botany at the B. P. Bishop Museum. The list includes some new island records and suggests that at least one species, *Achyranthes splendens* may no longer occur at PHR. It should be noted that *Eragrostis paupera* is a diminutive bunchgrass unsuitable as a nest substrate.

Another major nest substrate used on PHR was marine debris (Fig. 4). Marine debris is a highly heterogeneous assortment of man-made flotsam which washes ashore on these very remote islands; these objects are buoyant and are frequently made of plastic or styrofoam. Common marine debris on both Laysan and PHR includes plastic line or rope; plastic or styrofoam floats; various types of fishing nets; plastic toys, bottles, and cigarette lighters; glass bottles and floats; plastic crates, and laundry baskets (Morin 1987). Marine debris was never used as a nest substrate on Laysan.

TABLE 4

ABUNDANCE OF BUNCHGRASS (*ERAGROSTIS VARIABILIS*) ON LAYSAN ISLAND AND PEARL AND HERMES REEF

	Total vegetation (ha)	Number of *Eragrostis* clumps per island	
		1983	1989
Laysan Island	187	no estimate	349,300 ± 53,660[a]
Pearl and Hermes Reef	21.3	337 to 437 (total)[b]	538+ (total)
Southeast Island	12.5	20	2
North Island	4.4	200 to 300	34
Grass Island	2.2	17	42
Seal-Kittery Island	2.2	100	460+

[a] Based on an estimate from counts of 30 10 × 10 m quadrats.
[b] Based on estimates made by Sheila Conant and Wayne Gagne in 1983.

The 30 quadrats in which *Eragrostis* clumps were counted on Laysan Island averaged 34.9 ± 14.37 clumps per 10 m × 10 m quadrat (Table 4). The average number of clumps in the two vegetation associations sampled was not significantly different at the 0.05 level, so the data were lumped. Conservatively estimating that a minimum of 100 ha of Laysan's 187 vegetated ha are either the pure *Eragrostis* or the *Ipomoea-Boerhavia-Sicyos-Eragrostis* association yields a minimum estimate of 349,300 ± 53,660 clumps of bunchgrass on Laysan. On PHR, Conant's 1989 total *Eragrostis* counts yielded 538+ for the entire atoll. In 1983, estimates made by Conant and Wayne Gagne (Table 4) were only slightly lower than the 1989 counts, but Conant, who has spent two to five weeks at PHR in 1984, 1985, 1986, 1987, and 1989 feels Gagne's 1983 estimates (made during half hour insect collecting visits) of clump numbers were low on Grass and Seal-Kittery islands.

Thirteen man-made nest substrates have been used at PHR (Table 2), although not all of these objects are marine debris: the generator, swim flippers, and wetsuit were brought to PHR by researchers. At least eight of the nests found in debris had eggs or chicks, but the remainder may have had neither. All of the nests in man-made objects were on Southeast Island at PHR.

DISCUSSION

We believe there are four factors that influence nest-site selection in Laysan Finches. The first is weather, which varies from intense heat and dryness to windy, cold rain. The extremes of temperature and humidity undoubtedly pose thermoregulatory challenges to finches, especially to

young chicks incapable of temperature regulation. The second is disturbance; seabirds such as Laysan Albatross (*Diomedea immutabilis*) chicks may stand on plants containing finch nests, and Wedge-tailed Shearwaters (*Puffinus pacificus*) burrow under plants containing nests. Third, nest substrate availability is important; if a preferred plant substrate is uncommon or not present at all, a different substrate will be used, possibly at some cost to the bird, such as increased clutch mortality. Finally, although predation on the finches has rarely been observed, field observations suggest that Great Frigatebirds (*Fregata minor palmerstoni*), Bristle-thighed Curlews (*Numenius tahitiensis*) and Laysan Finches themselves are capable of preying on finch chicks or eggs (Dill and Bryan 1912, Walker 1961, Morin and Conant, unpubl. data).

The closely related, endangered Nihoa Finch (*Telespyza ultima*) has nested in captivity in cement blocks and pipes (Berger 1981), and on Nihoa Island they nest in rock crevices and holes (Sincock and Kridler 1977, Conant, unpubl. data). In the early part of this century, when the vegetation on Laysan was nearly eliminated by introduced rabbits, Laysan Finches nested in the crannies of human-made piles of guano blocks, in a manner reminiscent of their Nihoa relatives, and even in one of the guano mining buildings, which no longer exists (Ely and Clapp 1973).

We propose that substrate availability is an important factor that causes Laysan Finches to use different nest substrates on the two atolls. There were early reports of Laysan Finches nesting in the native bush *Chenopodium oahuense* (Fisher 1903a, Fisher 1903b, Rothschild 1893–1900), but by 1923 the plant had been extirpated by the introduced rabbits, which were themselves extirpated by 1924. However, observations made both before and after the devegetation of Laysan mentioned *Eragrostis variabilis* as the primary nest substrate on Laysan Island (Fisher 1903b, Ely and Clapp 1973, Sincock and Kridler 1977, Amadon 1950, Morin, unpubl. data). Laysan and the four islands at PHR have at least some *Eragrostis variabilis,* but *Solanum nelsonii* and the grass *Setaria verticillata* only occur at PHR (Table 4). *Setaria* was most commonly used on Southeast Island in PHR (Table 2), but on North Island, where *Setaria* does not occur, *Solanum nelsonii* and *Tribulus cistoides* were the most common nest substrates.

To summarize, *Eragrostis* occurs on all the islands, and is the preferred nest substrate on Laysan (Table 2), but it is seldom used on PHR, probably because it is relatively uncommon (Table 3). There are about 10,000 finches on Laysan, and about 800 finches at PHR. The ratio of bunchgrass clumps to finches on the two islands is dramatically different: about 35 clumps per finch on Laysan and <1 clump per finch at PHR. The PHR island with the most Laysan Finches, Southeast Island, has almost no

Eragrostis. This probably accounts for the fact that so many other nest substrates, such as *Setaria* and marine debris, were used there. *Setaria* is an introduced sod-forming (rather than bunch-forming) grass. Although the growth forms of *Setaria* and *Eragrostis* differ, the type of cover they provide for nests is similar. However, *Setaria* is shorter and less dense. North and Seal-Kittery Islands were the only PHR islands where *Eragrostis* was used as a nest substrate, either alone or in combination with other plants.

In the absence of data on the introduced finch population at PHR, one might conclude that Laysan Finches were obligate *Eragrostis* nesters. However, other plants that provide suitable, dense cover are selected as nest substrates when *Eragrostis* is uncommon. Although Laysan Finches are endemic to the hot, treeless atoll environment, their physiological heat tolerance is no better than that of most passerines (Weathers and van Riper III 1982). However, the basal metabolic rate of Laysan Finches is 20 per cent lower than would be predicted for a passerine of this size, indicating some adaptation to the warm environment (Weathers and van Riper III 1982). Because heat tolerance would be important to incubating birds forced to remain in the nest, nest substrate selection may represent a behavioral adaptation to the extremes of heat and insolation.

The presumed nesting requirements of the Laysan Finch (i.e., shelter from sun, rain, wind, and avoidance of predators or other disturbances) appear to be met by the plants or other substrates (e.g., Great Frigatebird nests) that provide the densest cover. It is unclear why finches on Southeast Island will nest in a wide variety of marine debris, but will not use wooden nest boxes. Inadequate size, poor ventilation and the presence of introduced, moisture-loving ants may explain the puzzle.

The fact that marine debris was not used as a nest substrate on Laysan Island suggests that appropriate nest sites are not limited. The frequent use of debris and other man-made objects as nesting sites on Southeast Island can be explained in several ways. First, suitable natural nest sites may be limited at Southeast Island at PHR. Second, relatively more man-made nest substrates are available because researchers (and their attendant gear) spend most of their time on Southeast Island when working at PHR. Third, more marine debris washes ashore on Southeast Island (Amerson et al. 1974), possibly due to its location in the reef (Fig. 2). Finally, the island was used for military exercises during World War II, was the site of unauthorized military operations in the 1950s, and was the site of a pearl oyster fishery in the late 1920s (Amerson et al. 1974). All of these human activities left various kinds of debris on the island.

Regardless of whether finches on Southeast Island prefer marine debris as a nest site or simply use it because suitable natural sites are limiting,

it is clear that our nest box designs appear to be unsuitable nest substrates. Should it be desirable to increase nest substrate availability (at least on Southeast Island), it may be most expeditious to simply increase certain types of marine debris.

The results of this study raise the question, "How do human actions affect adaptation of an introduced species to its new habitat?" Conant (1988a) has documented significant morphological differences in the Laysan and the introduced PHR Laysan Finch populations. Although these two atolls share many plant species, plant community structure is more complex on Laysan than on PHR, particularly at the level of nest substrate for a passerine bird. It seems quite possible that the differences in vegetation may exert selective pressure on finches in a number of ways. One might speculate, for example, that a nest in open and/or sparse vegetation or in a plastic crate may require different parental behaviors and energy expenditures than a nest in dense vegetation.

How Laysan Finches affect the plant species in which they nest is also of concern. In addition to invertebrates, eggs, and carrion, Laysan Finches eat a wide variety of plant species and plant parts, including *Eragrostis* seeds; the birds also destroy grass leaves when they mandibulate the stems. Descriptions of Southeast Island from the early 1920s and 1930s (Amerson et al. 1974) reported *Eragrostis* to be a dominant plant in the community. Wave overwash of this low (<4.5 m) island during a severe storm in 1930 is believed to have caused a major plant die-off. By 1974, *Eragrostis* was considered an insignificant component of the vegetation on Southeast Island (Herbst 1980, Amerson et al. 1974). Estimates in 1983 and counts in 1989 of the number of *Eragrostis* clumps (Table 4) show that at least one of the four islands at PHR experienced a decline of *Eragrostis* between 1983 and 1989.

Laysan Finch breeding was monitored after their introduction to Southeast Island at PHR in 1967. Summarizing data collected up to 1969, Amerson et al. (1974) stated that (on Southeast Island) "Most nests are in *Eragrostis* clumps and a few are in the moderately dense *Solanum.*" Later, Sincock and Kridler (1977) reported that 90% of the Southeast Island nests found from 1967 through 1974 were located in *Eragrostis.*

Finches feed on seeds of *Setaria, Tribulus, Eragrostis, Boerhavia,* and *Sonchrus.* We have observed them eating the seeds of nearly every species of plant at PHR, and Herbst (pers. comm.) found that *Eragrostis* inflorescences he examined on trips in 1981 and 1988 had been nearly stripped of seeds by foraging finches. High water in a severe 1969 storm destroyed the largest *Eragrostis* stand on Southeast, which had not recovered by 1974. How the storm affected the grass on other islands is unknown, although the vegetated portion of Seal-Kittery Island, where *Eragrostis*

is still quite abundant, is two to three meters higher in elevation than any of the other islands at PHR. We believe it is possible that the finches' feeding habits may have prohibited the recovery of *Eragrostis,* and possibly even hastened the decline of *Achyranthes splendens* at PHR. Thus, the vegetation composition at PHR may be effecting a change in the nest-site selection of the finches, while the finches may simultaneously be changing the composition of the vegetation.

Extrinsic factors such as thermal characteristics, substrate availability, protection from predators (especially predation of eggs by other finches) and disturbance, may all affect nest placement. According to Brown and Goertz (1978), Munro and Rounds (1985), and Osborne and Osborne (1980), the characteristics of potential nest substrates, such as height, sturdiness, and density of cover, may be more important than the species of plant used for a nest substrate. However, *Eragrostis* apparently provides the ideal substrate for Laysan Finch nests: insulation for nests from the sun and rain and protection from predators and other forms of disturbance. In addition, finches roost in *Eragrostis* clumps, eat its seeds and glean invertebrates from its foliage. Some shrubs (e.g., *Pluchea indica, Scaevola sericea, Tournefortia argentea*), and a small number of trees (one *Casuarina equisetifolia* and about thirty *Cocos nucifera*) occur on Laysan, but Finches have not used these as nest sites.

We have found that the nest substrates used by an introduced population may be unexpectedly different from those of the parent population if habitat composition and structure differ. Whether or not these differences have influenced divergence of the Laysan and PHR Laysan Finch populations is unknown. How the introduced finches have affected the plants and invertebrates at Pearl and Hermes Reef is also unknown. We believe that the conservation of the endangered Laysan Finch will require the maintenance of an unaltered ecosystem on Laysan where *Eragrostis* is maintained as a major vegetation component that provides food, roosting, and especially nesting sites for Laysan Finches.

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LITERATURE CITED

AMADON, D. 1950. The Hawaiian honeycreepers (Aves, Drepaniidae). Bull. Am. Mus. Nat. Hist. 95:155–262.

AMERSON, A. B., JR., R. B. CLAPP, AND W. O. WIRTZ II. 1974. The natural history of Pearl and Hermes Reef, Northwestern Hawaiian Islands. Atoll Research Bulletin, No. 174. Smithsonian Institution, Washington, D.C.

BERGER, A. J. 1981. Hawaiian birdlife. 2nd edition. The Univ. of Hawaii Press, Honolulu, Hawaii.

BROWN, B. T. AND J. W. GOERTZ. 1978. Reproduction and nest site selection by Red-winged Blackbirds in north Louisiana. Wilson Bull. 90:261–270.

CONANT, S. 1988a. Geographic variation in the Laysan Finch (*Telespyza cantans*). Evol. Ecology 2:270–282.

DILL, H. R. AND W. A. BRYAN. 1912. Report of an expedition to Laysan Island in 191'1. U.S. Dept. Agr. Biol. Surb. Bull. 42.

ELY, C. A. AND R. B. CLAPP. 1973. The natural history of Laysan Island, Northwestern Hawaiian Islands. Atoll Res. Bull., No. 171. Smithsonian Institution, Washington, D.C. ington, D.C.

FISHER, W. K. 1903a. Birds of Laysan and the Leeward Islands. Bull. U.S. Fish. Comm. for 1903. 23:769–807.

———. 1903b. Notes on the birds peculiar to Laysan Island, Hawaiian group. Auk 20: 384–397.

HERBST, D. 1980. July 1980 survey report for Pearl and Hermes Reef. Unpubl. Rept. U.S. Fish and Wildlife Service, Honolulu, Hawaii.

——— AND W. L. WAGNER. Alien plants on the Northwestern Hawaiian Islands. *in* Alien plant invasions in native ecosystems of Hawaii: management and research (C. P. Stone, C. W. Smith, and T. Tunison, eds.). CPSU/UH, Dept. of Botany, Univ. of Hawaii, Honolulu, Hawaii. In press.

LAMOUREUX, C. H. 1963. The flora and vegetation of Laysan. Atoll Res. Bull. 97:1–14.

MORIN, M. P. 1987. Laysan Finches drown as a result of marine debris. 'Elepaio 47:107–108.

MUNRO, H. L. AND R. C. ROUNDS. 1985. Selection of artificial nest sites by five sympatric passerines. J. Wildl. Manage. 49:264–276.

NEWMAN, A. L. 1988. Mapping and monitoring vegetation change on Laysan Island. M.A. thesis, Dept. of Geography, Univ. of Hawaii, Honolulu, Hawaii.

OLSON, S. L. AND H. F. JAMES. 1982. Prodromus of the fossil avifauna of the Hawaiian Islands. Smithsonian Contr. Zool. No. 365.

OSBORNE, P. AND L. OSBORNE. 1980. The contribution of nest site characteristics to breeding success among blackbirds *Turdus merula.* Ibis 122:512–517.

ROTHSCHILD, W. 1893–1900. The avifauna of Laysan and the neighboring islands: with a complete history to date of the birds of the Hawaiian possessions. R. H. Porter, London, England.

SINCOCK, J. L. AND E. KRIDLER. 1977. The extinct and endangered endemic birds of the Northwestern Hawaiian Islands. Unpubl. Rept., U.S. Fish and Wildlife Service, Honolulu, Hawaii.

THROP, J. L. 1970. The Laysan finch bill in the Honolulu Zoo. 'Elepaio 31:31–34.

U.S. FISH AND WILDLIFE SERVICE. 1984. Northwestern Hawaiian Islands passerines recovery plan. U.S. Fish and Wildlife Service, Portland, Oregon.

VAN RIPER, S. AND C. VAN RIPER III. 1985. A summary of known parasites and diseases

recorded from the avifauna of the Hawaiian Islands. Pp. 298–371 *in* Hawai'i's terrestrial ecosystems: preservation and management (C. P. Stone and J. M. Scott, eds.). Univ. of Hawaii Press, Honolulu, Hawaii.

WAGNER, W. L., D. R. HERBST, AND S. H. SOHMER. 1990. Manual of the flowering plants of Hawaii. Univ. of Hawaii Press, Honolulu, Hawaii.

WALKER, R. L. 1961. Excerpts from Leeward Island journal Sept. 2nd to 12th, 1961. Unpubl. Rept., Division of Forestry and Wildlife (previously Hawaii Dept. of Fish and Game), Honolulu, Hawaii.

WEATHERS, W. AND C. VAN RIPER III. 1982. Temperature regulation in two endangered Hawaiian honeycreepers: the Palila (*Psittirostra bailleui*) and the Laysan Finch (*Psittirostra cantans*). Auk 99:667–674.

WILSON, S. B. 1890. On a new finch from Midway Island, North Pacific. Ibis 33:339–341.

SIGURD T. OLSON COMMON LOON RESEARCH AWARD

LoonWatch is accepting applications for its sixth annual award for research on Common Loons in the Western Upper Great Lakes region of the United States and Canada. To apply for cash awards up to $2000, a brief description (maximum 10 pp.) of the proposed research program and curriculum vitae should be submitted by the principal investigator to Terry Daulton Dunn, Coordinator, LoonWatch, Sigurd Olson Environmental Institute, Northland College, Ashland, Wisconsin 54806. Proposals must be received by January 10, 1991. Proposals by students should be accompanied by two letters of recommendation. The award will be granted on the basis of the project's potential to better understand and manage Upper Great Lakes populations of Common Loons. Guidelines for applicants are available from LoonWatch.